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Repair and renovation of flood-damaged buildings

This digest is intended to help architects, surveyors and builders with the problems they are likely to face when dealing with property damaged by flood water. It describes the possible effects of flooding on materials and structures and the various types of damage that may be caused. Appropriate remedial measures are given but these may be modified in some cases depending on the particular circumstances of flood damage.

Before starting work on a structure that has been flooded, electricity, gas and water services should be tested and isolated if necessary.

Draining

All water trapped in or around the building should be drained or pumped out as soon as possible, drilling drain holes in walls if necessary. Check for water trapped in:

1 Underfloor air ducts.

2 Service access pits.

3 Cavities in cavity walls.

4 Areas under the building where the level of the site concrete or ground is below that of the adjoining ground outside the building.

Cleaning

Mud above dpc

Apart from the normal cleaning-up of mud and silt, any earth, mud or debris that has accumulated against the walls above the damp-proof course must be cleared away as soon as possible otherwise it will hinder the drying of the walls. All airbricks and ventilators should be cleared.

Underfloor spaces

Mud that has found its way under boarded floors should also be removed. The underfloor space should be sprayed with disinfectant for health reasons and the Local Authority should be consulted so that their recommendations can be implemented.

Cavity walls

The flooding of cavity external walls may leave mud bridging the cavity above the damp-proof course which, if not removed, could lead to permanent rising dampness. Where there is such a risk the cavity should be inspected, removing an occasional brick if necessary, and any mud present raked or flushed out. The cavity behind wall linings should be inspected and cleaned out if necessary.

House after flooding showing depth of flood water

Drying

After cleaning, the structure should be heated and ventilated as much as possible; the continuation of warm air ventilation promotes drying and is essential *if further damage is to be minimised.*

1 Keep windows and doors open as much as possible even when a fire is lit or heaters are used.
2 Take up loose floor coverings, dry and store them.
3 Lift floorboards preferably near walls to increase draught under the floor. Consider installation of extra ventilators.
4 Wallpaper may have to be stripped and any wall panelling removed.
5 Keep furniture and pictures away from affected walls otherwise they will slow down the rate of drying.
6 Open cupboard doors.

Brickwork and plaster

Porous building materials absorb large quantities of water during flooding. A one-brick wall, for example, may have absorbed as much as 55 litres per m^2. This water will take months to dry out. Any salts appearing on the surface of the brickwork or plasterwork should be brushed off dry—if more appear it is a sign that the structure is still drying out. Where both sides of a wall are impervious, for example gloss painted, it may be necessary to remove the covering on one side.

Masonry

The denser types of natural stone absorb very little water and will therefore dry out more quickly but if the masonry has an infilling of porous material, such as a rubble hearting, that has become saturated drying will take a long time.

Timber

All timber must be dried as soon as possible to minimise the risk of fungal attack. The risk is greater the longer it remains moist. New outbreaks of decay are unlikely if the timber is dried within a few weeks.

The risks of timber distorting or splitting from too rapid drying must be balanced against the need to dry out the building as soon as possible. Such damage to timber can be minimized by promoting drying from both faces, for example, by removing panelling from walls or lifting floorboards.

Skirting boards, door frames, sills and joist ends and ground-floor timbers generally attached to, or embedded in, damp walls are in the most vulnerable positions and should be carefully examined. The surface of timber may look and feel dry long before the interior dries. A moisture meter with deep probes should be used to check the drying process.

If the measures already suggested for drying out have been taken, the risk of rot will be greatly reduced, but it is recommended that the underfloor be re-inspected after six months and again in twelve months time. Inspection of timber floors may reveal parts that have been suffering from decay for a long time, though not sufficiently extensive either to have caused structural failure or even to have been noticed before flooding led to detailed examination. Long-standing rot of this kind seen in some buildings has been found to be due to earth piled up against the walls above the damp-proof course. Flooding may accentuate this unnoticed decay unless precautions are taken to eliminate its causes.

Long-term effects on sand/lime bricks ten years after flooding by sea-water

Effect of water on materials

Brick, stone and concrete

Water is unlikely to have any serious effect on these materials unless the flood water contained a high proportion of sea-water when there may be long-term effects such as surface powdering and flaking of soft brickwork.

Lightweight concrete with its relatively high moisture movement may have expanded on wetting and therefore shrink on drying. This may eventually lead to some cracking.

Materials in external walls are unlikely to be damaged by frost as the flooded sections are not severely exposed. Dwarf free-standing boundary walls may suffer frost damage if very wet.

Wall finishes

Strong undercoats of cement and sand, or cement, lime and sand, are unlikely to be affected, but lime–sand or black ash mortars in older houses may become friable. Damage is more likely in houses that have been flooded more than once.

Plasterwork based on calcium sulphate plasters may be soft while wet and harden to its original state on drying but some may remain weak and in some instances re-wetting may have caused a delayed expansion with rippling and buckling of the plaster finish.

Plasterboard and fibreboard are soft while wet but may dry out without much warping or twisting. On ceilings the boards may sag.

Asbestos-cement sheeting is unlikely to have been harmed but because it has been saturated it should be re-decorated as for new asbestos-cement.

Timber

Timber swells and distorts on wetting. When swelling occurs under restraint permanent damage may occur which will show up on drying, for example, as excessive gapping between floorboards. Most types of chipboard swell on wetting and suffer permanent weakening. The risk of decay has already been discussed above.

Floor finishes

Permanent floor finishes other than timber and chipboard are unlikely to have been affected. Timber may have swollen and caused buckling of floorboards and lifting of wood blocks. Where water-sensitive adhesives have been used to fix floor coverings to a concrete screed some loss of adhesion may result. Re-use of affected materials depends on their condition after drying out.

Metals

Metals are unlikely to have suffered much damage unless the flood water was contaminated with salts. In factories where such contamination may have occurred metal surfaces should be washed where accessible as a precaution against accelerated corrosion. Locks and hinges should be oiled to prevent rusting.

Structural damage

Structural damage can occur if there has been severe buffeting by flood waters. Simple immersion is unlikely to cause such damage.

Foundations

Damage to foundations may occur during drying-out if the subsoil is shrinkable clay. This swells when wetted and may crack brickwork. No repointing should be done until the ground has dried out since cracks may close as the ground shrinks. The effects of scouring and erosion will usually be obvious and must be remedied. Such damage may not be confined to the foundations and a detailed examination of the whole structure should be made before deciding on remedial measures.

Structural failure caused by severe buffeting by flood water

Walls

The factor of safety of brickwork is so great that minor cracking can generally be ignored unless this occurs in very narrow piers of brickwork between windows and door openings.

Floors and roofs

Structural damage to floors and roofs is usually the result of serious damage to supporting structures or weaknesses existing before flooding. However, possible weakening of, for example, chipboard may need to be considered.

Concrete solid ground floors will normally be undamaged unless they were already seriously cracked or of weak construction, but there may be long-term troubles from some materials used for hardcore such as burnt colliery shale or chalk.

Paths and driveways
Surfaces should not be reinstated until swollen subsoils have returned to their normal condition. Hardcore and blinding may have been washed away and need replacement.

Drains
If inspection covers were removed to facilitate the draining of surface water, silt may have built-up in drain runs and caused blockages.

Renovating interiors

Walls
The re-decoration of walls, with replastering where necessary, can follow normal procedures, bearing in mind that if the work has to be carried out before the walls have thoroughly dried the same precautions should be taken as for new work. Porous coatings should be used since they will allow evaporation to continue. Wallpaper should not be applied too soon on damp walls. If mould growth is already present, treat walls with a suitable fungicide before re-decoration.

Timber
The main problem in renovation concerns timber—particularly that in suspended ground floors. Much depends on the original condition of the woodwork before flooding and the rate at which it has subsequently been dried. Wherever possible a sufficient number of the floorboards should be lifted to allow a thorough inspection of the floor joists. If there is any doubt as to the state of dryness of any of the timbers the moisture content should be measured by means of a moisture meter. If this shows a reading of more than 20 per cent, further drying is necessary before any more work is done. (The presence of salt water may cause unreliable readings.) There should be no contact between the ends of the joists and the walls, but if there is it should be broken either by cutting off the ends of the joists or by removing any rubbish that has accumulated in the gap. The opportunity should be taken to replace any decayed timbers by pressure-impregnated timber. If the ground or over-site concrete appears to be damp it would be wise to leave the floorboards off for a time to encourage drying. The importance of thorough drying to avoid decay by fungal growth cannot be too strongly emphasised.

It is seldom practicable to remove door frames, window frames, sills or stair stringers and drying operations must be relied on to reduce the risk of fungal growth.

Valuable timber panelling should be removed to allow drying out. It should be allowed to dry and be replaced only when the walls have dried otherwise water vapour will be transmitted from the wall to the back of the panelling and any battens or strapping providing conditions favourable to fungal growth.

Panelled doors are unlikely to be affected unless the panels are made of plywood in which the plies are bonded with water-sensitive adhesives.

Flush doors may be more severely damaged and require replacement. Much depends on the details of the design and the materials used. Generally there is no difficulty in deciding upon the course of action required.

Swollen doors and opening lights should not be planed until drying and shrinkage are completed.

Linoleum and other impervious floor coverings should not be relaid on timber floors until they are thoroughly dry; rugs and carpets without rubberised backings may be safely used when the floor surface is dry.

Electrical installations

Electrical installations that have been immersed should be disconnected until tested by an electrician and all appliances should be examined and tested.

Connections
All terminations and other unsealed connections must be exposed, examined and cleaned if necessary. All water must be mopped up and terminations left open until dry. When clean, each connection should be examined for surface tracking across insulation surfaces that may have been produced if the supply had been switched on while the installation was still wet. Where this has occurred the component should be replaced.

Ducts, conduits and cables
Water trapped in ducts or conduits must be removed. Inspection elbows and conduit boxes can be opened to facilitate draining.

Plastics covered cable should not be affected by immersion but rubber insulation may be damaged and need replacing.

Tests
After cleaning and drying the installation should be tested for earth continuity and insulation resistance (as laid down in the current IEE Regulations) and an inspection certificate obtained.

Future arrangements
Since the installation may have to operate in a damp atmosphere for up to a year, the insulation may fail

due to tracking in moisture films. The occupier should be advised to look for overheating at socket outlets, sizzling, crackling or buzzing, or emission of smoke or steam. If these occur the electricity supply should be switched off at the main immediately.

Trouble may also arise from the rusting of ferrous metal components which may affect the earth return path in steel conduit installations. Clips around socket tubes in socket outlets may also rust causing poor contact at the pins and possible local overheating. Rust attracts moisture and its formation on the inside surfaces of outlet boxes encourages the retention of moisture.

The electrical installation should be inspected and tested at monthly intervals for the first six months and at least twice in the following six months.

Flooded stocks of building materials

Some builders and builders' merchants will have had stocks of building materials flooded, either on sites in course of development or in their own yards. Much of this material can be used provided certain elementary precautions are taken.

Porous materials such as bricks, stone or tiles that have become saturated with water will require at least a certain amount of drying before use. Those sensitive to frost attack should be temporarily covered in frosty weather, and any that have been lying on frozen ground, at the bottom of stacks for example, should be discarded.

Timber will have absorbed water to an extent dependent on how long it has been immersed. Most absorption occurs at the exposed end grain and in sap wood. The timber must be open-piled and re-dried before use.

Some sheet materials such as asbestos-cement may be little affected, and can be put aside and allowed to dry. Wet plasterboard and fibreboard may be too weakened to withstand handling to permit drying and much of it may be unusable. If wetted, chipboard, strawboard and plywood not resistant to water must be rejected.

Glass stored in crates should be examined as a film of water may have been trapped between the sheets. If so, the sheets should be taken out of the case and dried before being re-stored. Water allowed to remain may set up a chemical reaction causing a surface discoloration of the glass, and this is not easily removable. Other products packed in straw, such as sanitary goods, should also be examined and wet straw removed to prevent possible staining.

Metal sheets should be separated and allowed to dry. Iron and steel goods should be dried as quickly as possible to prevent rusting.

Sea-water flooding

Sea-water flooding creates additional problems. Walls contaminated by the deliquescent salts in sea water may remain permanently damp. The salts also promote severe corrosion of any metal fastenings and are likely to corrode electrical installations.

Timber tends to remain damper when contaminated by sea water, but there is no evidence to suggest an increased risk of rot; the fungicidal effect of the salt appears to compensate for the increased dampness.

Check-list

A summary of points to check when dealing with flood-damaged buildings.

Draining

Drain or pump out any water trapped in:

1 Underfloor air ducts
2 Service access pits
3 Wall cavities
4 Site concrete below ground level

Cleaning

1 Clear mud above dpc
2 Remove mud under boarded floors and disinfect space
3 Rake or flush out mud in wall cavities

Drying

Ventilate structure as much as possible:

1 Keep windows and doors open
2 Dry and store floor coverings
3 Remove wallpaper and wall linings
4 Ensure adequate air flow under suspended timber flooring
5 Keep interior walls clear

Oiling

Oil locks and hinges

Structural damage

1 Check floors and roofs for damage caused by disruption of supporting structures or resulting from previous weaknesses
2 Re-point cracked foundation brickwork *after* ground has dried out
3 Examine whole structure for scouring and erosion and repair damage
4 Repair paths and driveways *after* swollen subsoils have returned to normal

Renovating interiors

1 Use porous coatings on walls
2 Treat any mould growth on walls with fungicide
3 Allow walls to dry out before papering
4 Check moisture content of floor timbers—if appreciably more than 20 per cent continue drying
5 Inspect timber floors for rot and re-inspect regularly for one year
6 Replace decayed timber by pressure-impregnated timber
7 Do not plane swollen doors and opening lights until dry
8 Replace linings and panelling only when walls are dry

Electrical installations and appliances

1 Disconnect installations affected until tested by an electrician
2 Leave unsealed connections open after cleaning and drying. Replace if surface tracking present
3 Drain any water trapped in ducts or conduits
4 Check rubber insulated cable for damage
5 Test system after renovation according to IEE Regulations and re-test regularly for one year
6 Examine and test all affected appliances

Stocks of materials

1 Cover wet porous materials during frost
2 Open-stack timber to re-dry before use
3 Separate sheet materials to dry
4 Remove glass from crates and dry before use
5 Remove wet straw packing from goods such as sanitary ware

Sources of further information

Dampness	
Rising damp in walls	Digest 27
Damp-proofing solid floors	Digest 54
Damp-proof courses	Digest 77
Damp-proof courses	Advisory Leaflet 23
Dampness in buildings	Advisory Leaflet 47
Inserting a damp-proof course	Advisory Leaflet 58
Timber and woodwork	
Design of timber floors to prevent decay	Digest 18
Prevention of decay in window joinery	Digest 73
Dry rot	Advisory Leaflet 10
Care in the use of timber	Advisory Leaflet 29
Woodworm	Advisory Leaflet 42
Maintaining exposed woodwork	Advisory Leaflet 62
Brickwork	
Mortars for jointing	Digest 58
Cracking in buildings	Digest 75
Efflorescence and stains on brickwork	Advisory Leaflet 75
Painting	
Painting woodwork	Digest 106
Control of lichens, moulds and similar growths	Digest 139
Painting new plaster and cement	Advisory Leaflet 1
Painting woodwork	Advisory Leaflet 25
Painting asbestos-cement	Advisory Leaflet 28
Emulsion paint	Advisory Leaflet 37
Plastering	
Plaster mixes for inside work	Advisory Leaflet 9
Plasterboard dry linings for houses	Advisory Leaflet 64

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